

“Feasibility of Multi-species Cover Crops  
In Central Virginia Cropping Systems  
To Affect Soil Quality”

Project Manager

James Tate

August 2012 to September 30 2015

Award Identifying Number

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## Executive Summary

The Multi-species Cover Crop Project idea was conceived by Jim Tate on the belief that achieving biodiversity would lead to the hosting of a larger range of species, that of plants, animals, insects and birds above and in the soil. This biodiversity would also lead to a greater microbial diversity in the soil, thereby improving soil health and crop productivity. In turn, more microbial diversity may contribute to an increase in biomass production, higher carbon sequestration, restoration of the water and nutrient cycles, and reduction of pests, disease and crop failures.





It was with this belief that Jim envisioned a project that producers in central Virginia would carry out, the widespread use of multispecies cover crops on a regular basis for a period of three years to improve soil health. The project began in August of 2012 and ended in September of 2015, a period of three years. District staff with Hanover-Caroline, Henricopolis, Tidewater and Northern Neck Conservation Districts recruited participants within their own service areas. Participants were recruited from all types of agriculture that could incorporate cover crops, and included small grain, vegetable, cattle and dairy producers. The staff of these districts assembled thirty-five participants, who each received enough seed to plant a five acre plot each year for a period of three years. The objective was to introduce the concept of multispecies cover crops to producers and allow them to assess their benefits and gather results. Because some producers preferred a summer cover crop, namely the vegetable and cattle producers, a summer cover crop mixture was offered as well. This plan allowed producers to explore, discover and solve problems associated with the planting of multiple species of seed in one planting and the resulting tons of biomass.

By the response of the participants, the project was an overwhelming success. They embraced the project in the first year with great enthusiasm, and participants expanded the program of their own accord by expanding the acreage in the second and third years of the program, paying for the extra seed themselves. The additional orders lowered the price of the seed and made it even more affordable. At the beginning of the program, there was no available vendor for multispecies cover crop seed, and no local vendor willing to make a seed mix at an affordable price. By the end of the program, local vendors and companies, after becoming aware that there was a market for this type of product, began to carry multispecies mixes and the project participants were beginning to buy from local vendors for the extra acreage they intended to plant. This was an unforeseen benefit of this grant project; an actual market was created for the multispecies mix, and multispecies mixes became available at affordable prices by the time the program ended.

The project was completed within the three year time frame originally planned, and the staff was still fielding calls from producers who wanted to join the program this past fall.

The staff of the districts involved were able to accomplish this without using all the funds that had been allocated for the grant. NRCS was able to use approximately 18,000 dollars originally allocated to this project to fund other projects.

The results of the CIG grant project have been shared around the state, and even nationally at the National Association of Conservation Districts Annual Meeting in New Orleans in January 2015. The districts have held many events to highlight the project to the producers around the region, beginning with a Growers meeting in Fredericksburg in February 2013 and ending with

a meeting in Rockville, Virginia in September of 2014 geared toward planting the multispecies cover crop for grazing cattle.

## **Introduction**

The project manager was Jim Tate from Hanover-Caroline SWCD, a conservation specialist who conducts conservation planning and works with producers within the Virginia BMP cost share program. Jim's sixteen years of experience with the district and well developed relationships with central Virginia's progressive producers enabled him and other district staff to recruit participants for the project. Marian Moody was the administrative manager for the grant.

Other districts and partner agencies that were involved with the project:

### **Northern Neck SWCD**

Brandon Dillistin, District Technical Manager,

Sam Johnson, Non-Point Source Specialist

Kathy Clark, District Operations Manager

### **Tidewater SWCD**

Carl Thiel- Goin, Conservation/Education Specialist

### **Virginia Cooperative Extension**

Mike Broaddus, Caroline County Extension Agent

Stephanie Romelczyk, Westmoreland Co., Agriculture and Natural Resource Crop & Soil Sciences

Dr. Chris Teutsch, SPAREC (advisor)

Jim Schroering, Hanover County Agriculture and Natural Resources agent,  
who left the project because of another employment opportunity.

### **Virginia Polytechnic Institute and State University**

Dr. Wade Thomason, Assistant Professor/Grains Specialist Virginia Polytechnic Institute and State University, Blacksburg, VA (advisor)

## NRCS

Chris Lawrence, State Cropland Agronomist (advisor)

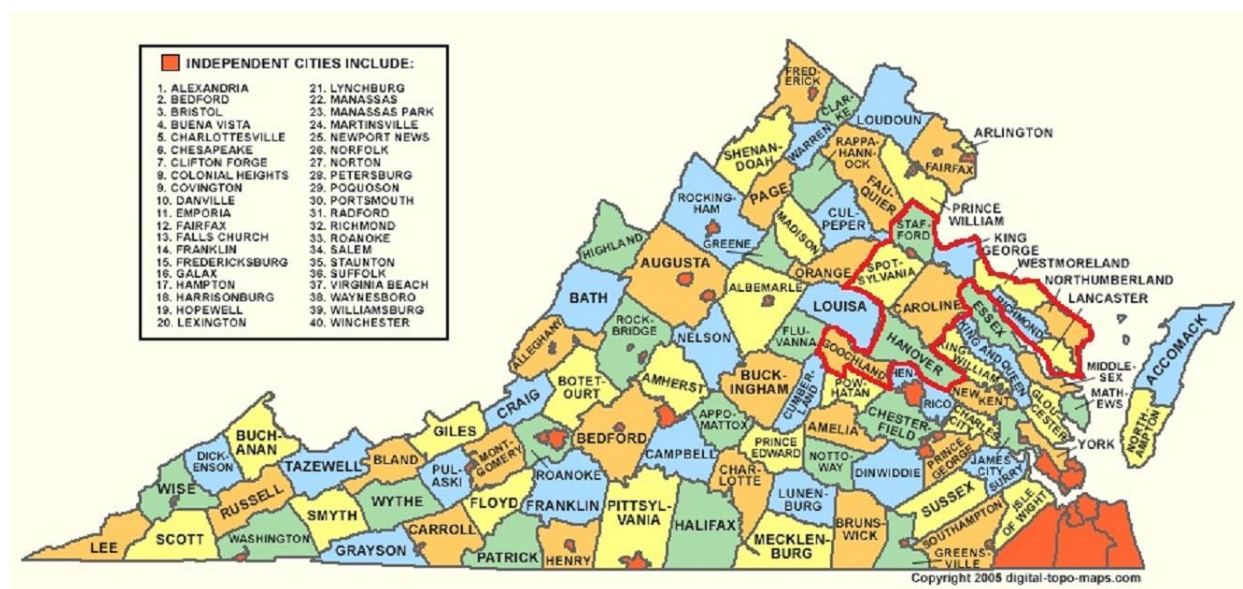
JB Daniels, State Forage and Grassland Agronomist (advisor)

The primary resource concern for this project was soil quality. Key objectives of the grant project were to promote among Virginia farmers and their advisors the use of multi-species cover crops, and develop better awareness of soil health and management practices for soil health improvement. The goal was to encourage local producers to move beyond the conventional short term rye cover crops and develop a more widespread understanding and achievement of cover crop benefits. Another objective was to showcase through on-farm demonstrations the beneficial impact of multi-species cover crops on the performance of subsequent harvested crops, the cycling of nitrogen and other nutrients, and lessen the need for off-farm fertilizers and prevent nutrient loss. Another key objective was to promote the role of the cover crop in overall farm profitability, by demonstration of the different roles that cover crops could play dependent on the goal of the producer.



A secondary goal was to support native pollinators in the establishment of colonies near cropping areas. The multispecies diversity through cover crops naturally supported pollinators with an ongoing supply of legumes and forbs that supplied abundant forage. The diversity and abundance of flowering legumes and other forbs benefited and served as “temporary bee pastures” (USDA Agroforestry). The multispecies cover crops provided a succession of bloom throughout the fall and spring seasons, when other blooming species were less available. Having a repeating multispecies cover crop on the same fields (or on fields within 800 feet) over a period of three years encouraged the establishment of new colonies in the area of the cover crop project, thereby benefiting the producer with his other crops. (USDA).

The project area covered 13 counties in central Virginia, encompassed by three districts, Hanover Caroline, Tidewater and Northern Neck.



The project was funded through a Virginia NRCS Conservation Innovation Grant in which the grant funded 50% of the funding for seed supplies and equipment to document the story of the grant results. Districts paid for events throughout the project area to educate the public as to the benefits of multispecies cover crops and the support of pollinators. The producers' contributions were their land, equipment, labor, and fuel in implementing the cover crops. However, the unanticipated reaction from the producers was the overwhelming acceptance of the multispecies cover crop in the early stages of the program, resulting in a widespread expansion of the project.

## Background

Production and profitability has always been the driving factor in all sectors of agriculture. Current cropping systems have been reduced to the most profitable species and are usually related in nature. Agriculture has concentrated on increased productivity and thereby created monocultures, dependent on conventional fertilizers and chemical pesticides. The interrelationship between soil, plants and animals have not been taken as seriously and, as a result, the land, soil and water have suffered. The environmental impacts that have resulted are soil erosion, chemical contamination of our waterways and food, the destructive and wasteful use of fuels and loss of our biodiversity.

Restoring biodiversity in the agro ecosystem may lead to a larger range of species, including plant, animal, insects and birds above and below ground. This in turn will lead to a greater microbial diversity in the soil. Biodiversity in an agro ecosystem may “contribute to constant biomass production and reduce the risk of crop failure in unpredictable environments, restore disturbed ecosystem services (such as water and nutrient cycling), and reduce risks of invasion, pests and diseases through enhanced biological or direct control of pests (Gurr et al.). “Multispecies systems can sequester more carbon over pure crop stands (Scopel E. et al.)”. “Cover crops may also enhance the soil carbon content, thus participating in climate change mitigation (Malezieux et al.)”.

The escalation of input costs and the decrease in world-wide nutrient sources require agronomy to seek more sustainable practices. Multispecies cover crops may be an advantage in nutrient cycling, with “co-existing species exploring different soil depths.” (Malezieux et al.) As to whether a cover crop will improve productivity is still unproven, however, the cover crop will improve sustainability in its resiliency, essentially insuring stability of the cover crop against total cover crop failure because of environmental fluctuations. Natural pest regulation through dilution, barrier, and biocide effects could lower the need for pesticides (Malezieux et al.) In Virginia, and other states which face water quality problems, the movement of state and federal programs to address water quality has included the use of cover crops as a tool. The use of multispecies cropping systems has only recently been incorporated into federal programs, and multispecies cover crops have not been incorporated at all in the Virginia state conservation programs, possibly because of the species restrictions of the Bay Model. In fact, “methods for designing multispecies systems barely exist”, according to Eric Malezieux and other authors of the article review, “Mixing plant species in Cropping Systems: Concepts, Tools and Models”.

Another unintended consequence of intensive agriculture has been the elimination of native pollinator habitat. Because the productivity of many food crops benefit from the presence of pollinating insects, the decline of pollinators is a major threat to agricultural production both in this country and abroad.



A study by Marcelo Aizen and others published in the *Annals of Botany* determined that “cultivation of pollinator-dependent crops has, on average, been expanding faster than that of non-dependent crops in both developed countries and those still developing over the period 1961-2006, so the demand for pollination service is rising at the same time that pollinator abundance and diversity are declining. In the near future, such opposing trends threaten crop yields...” The current monoculture of rotations also cause a feast or famine effect for native pollinators. Crops, all planted at one time, reach peak of bloom at one time, and then leave a lack of food sources for the rest of the season.

Districts and Extension partners identified thirty five producers from various areas of agriculture; commercial grain producers, four vegetable operations, one strawberry grower, three livestock graziers and two dairy producers who expressed an interest to participate in the MSCC project. There was also one operation where the producer was transitioning land from small grain cropland to pasture and intended to improve the soil during the transition. Two other plots were wildlife establishments. These were all areas of agriculture in which multispecies cover crops could be implemented to benefit soil health, and therefore their agronomic system. These innovative producers were identified to explore methods in which to use the MSCC to improve management and soil quality in a manner that would fit into the cropping systems prevalent in central Virginia.

## **Review of Methods**

One key objective of the grant project was to promote among Virginia farmers and their advisors the use of multi-species cover crops and better awareness of soil health and management practices for soil health improvement. The goal was to encourage local producers to move beyond the conventional short term rye, wheat and barley cover crops and develop a more widespread understanding and achievement of cover crop benefits.

Jim Tate and other district personnel were able to recruit 35 producers (ten more than the 25 originally planned) from the central Virginia, Northern Neck and Tidewater areas to participate in the project. The varieties of production agriculture included vegetable, dairy, small grain, and cattle. Additionally, a number of producers who were not eligible for the program, such as some goat and beginning farmers, were nonetheless inspired to experiment with the multispecies mix at their own expense.

Originally, producers were recruited to plant one five acre plot with the MSCC seed provided and incorporated into his normal operation. This plot was to be matched with another similar (ideally alongside) plot in which the producer continued in his normal operation and fertility program (without the multispecies cover crop). The producer was expected to cut back his nitrogen application in the proceeding crop on the MSCC plot by 25%, with his normal application on the plot without the MSCC. The grant project district and Extension staff were

planning to take care of the soil testing and monitor yields. With the loss of personnel and difficulties gaining the right equipment during the project, the soil testing and yield monitoring was difficult to carry out. It was decided during the project to amend the grant to include the making of informational videos using the producers' testimonies for use on the internet.

One early obstacle in the project involved the purchase of a weigh wagon for weighing biomass. District personnel were unable to find a weigh wagon to purchase in the area. The closest equipment available was in the Midwest, and the equipment found there was not actually suitable for the project. The second obstacle faced in the project was the loss of one of the partners, Jim Schroering, the Agriculture Extension Agent for Hanover County. He left his Extension job for another employment opportunity. This affected the soil sampling component and biomass yield tests, as Jim Schroering was the person set to handle this part of the project. A third obstacle was the loss of Henricopolis as a partner because of staff turnover there and the loss of their two producers. (We were not given the producers' contact information. These were the only producers that were lost during the program.) The predicted producer attrition rate did not occur, and the few producers that were lost due to the Henricopolis staff turnover were quickly replaced by others eager to join the program.

Managing the selected plots was a limitation that had to be faced. Several producers experienced high turnover of properties during the project time span due to the competitive bidding rental rates during the time of high grain prices, land sales and lost control of the plot locations. Those producers were encouraged to continue the project at another location.

Another obstacle faced by planners was the inability to find a local vendor who was willing to make the mix to project specifications at an affordable price.

In recruiting the producers, Jim Tate found that all the producers asked the same four questions.

Why use this mix? Jim was able to explain the purpose of the project in answer to this question.

What is in the mix? A significant number of high quality producers who signed up for this project, some of whom were seed producers, objected to the use of rye, ryegrass and vetch. This gave rise to a tweaking of the mix to accommodate these producers and keep them involved with the project. This in turn gave birth to the concept of not using a one size fits all mix, because rye, ryegrass and vetch have been proven to be very valuable cool season cover crops.

How do I plant it? The staff informed the producers that "this is what we intended to learn from them." The plan was to allow producers to incorporate this type of cover crop in a way that suited their operation and equipment with no limitations, and gather information about methods.

What does it cost? It was determined from the beginning that the mix should be affordable to be accepted and considered for eventual incorporation into their operations. Each producer initially considered the seed cost, even though the seed was given to them for the five acre planting. During the project time span, it was soon determined that 40 to 45 dollars a bag was the upper

limit of what was acceptable and affordable to producers willing to purchase extra seed for the project. This was one unexpected benefit of keeping seed costs down, producers were willing to expand the project to more acres at their own cost. This very willingness to expand the project is what reduced seed prices even further, because freight rates came down with higher volume orders. Not able to find a local vendor who would make the mix (which is what was preferred), the search area was broadened, and Green Cover Seed was contacted, based in Bladen, Nebraska. They were willing to create the mix to specifications, and so the last obstacle became the freight charges. The staff decided to take orders for additional seed, and the producers' response was phenomenal. The producers' interest in purchasing additional seed eliminated the freight obstacle, and the first year the order was for over 90,000 lbs. of seed, bringing seed costs down considerably.



The first year, Jim Tate developed the seed by first researching the benefits, drawbacks and limitations of the many types of individual species, and potential suitability to perform in a mix. Using traditional and nontraditional cover crop species using these parameters, he began to put together classes and costs, and began to formulate a mix. Jim had input from many agronomic professionals, including NRCS advisors Chris Lawrence and JB Daniels, as well as Ray Archuleta

and agronomists from various seed companies. The goal was an 8 to 10 species mix that would work at an affordable price. Jim discovered that the mixes had to contain some tillage radish seed. Producers were enamored with this new species and did not recognize that it had its limitations.



After research, the conclusion was the first year high diversity multispecies mix should be a broad spectrum of species and must include one or more legumes, one or more grasses, and one or more of the brassicas, broadleaves or forbs.



Mix Analysis

Green Cover Seed 932 Road X Bladen, NE 68928 402-469-6784

Customer: **Hanover INRCS** Mix: **Mix #2**

Seeding Rate: 50 lbs/acre 9/4/2012

	%	Lot	Origin	Germ	Purity	Other	Inert	Weeds	Test
<u>Clover-Crimson</u>	4%	M9-10-DC	OR	85%	65.0%	0.0%	35.0%	0.0%	A-11
<u>Winter Pea</u>	20%	L86P810208	OR	90%	99.6%	0.0%	0.0%	0.0%	J-12
<u>Clover - Yellow Sweet</u>	2%	L129CL9	OR	82%	65.0%	0.1%	34.5%	0.0%	F-11
<u>Clover-Red</u>	2%	73-10-RC29	OR	80%	64.9%	0.1%	35.1%	0.1%	N-11
<u>Oats</u>	20%	PF10	NE	97%	98.0%	0.0%	2.0%	0.0%	F-12
<u>Winter Wheat</u>	20%	PF11-OPC	NE	90%	98.0%	0.0%	2.0%	0.0%	J-12
<u>Triticale - winter</u>	20%	TR3-347	NE	96%	98.8%	0.0%	1.2%	0.0%	A-12
<u>Nitro Radish</u>	6%	P27-11-103C	OR	96%	99.9%	0.0%	0.1%	0.0%	M-12
<u>Rapeseed</u>	4%	RP-11	ID	90%	100.0%	0.0%	0.0%	0.0%	F-12
<u>Turnip (purple top)</u>	1%	P4000	OR	90%	99.9%	0.0%	0.1%	0.0%	A-12
<u>Yellow Mustard</u>	1%	50271-8	OR	91%	100.0%	0.0%	1.0%	0.0%	M-12

The first year mix formulation can be seen in this photo.





**Five Acres of the mix planted in the first year**

By the second year of the project, the concept became clear that cover crops needed to be purpose driven, and one type of mix did not fit all purposes. Also, the seed species which were banned from the original mix were known to have real value, and the staff wanted to make them available.

This revelation gave rise to the intent to develop four different mixes for the second year of the project, each serving a specific purpose, and Jim Tate eventually developed the following range of mixes for the producers. Producers had the option as to which mix they would receive for their 5 acre allotment. The four mixes are detailed below:

The Green Cover High Diversity Mix- This was considered to be the Cadillac mix, which was designed to be seeded as early as possible and terminated in April or later. This mix was designed to have a high degree of diversity in the plant community for its enhancement of the soil biota. The mix included ten species and three of the four plant cover groups. The species were selected because of the following traits: atmospheric nitrogen fixation, deep rooting compaction breakers, early bloom in the spring for pollinators, biomass production, wildlife friendly, allelopathic effect, and grazing possibilities.

The Green Cover Nitrogen Builder, was designed for nitrogen addition and fixation ideally seeded by Labor Day and not terminated until April or later. The nitrogen builder mix was designed to build soil quality, and species were selected for the following qualities: Improvement of poor land, easy establishment, good interaction, complementary nitrogen fixers, winter hardiness, and compaction breakers.

The Green Cover Late Seed Mix- This was an option for late seeding with a target no later than October 15 with a termination about May 1<sup>st</sup>. This was comprised of 20% barley, 50% triticale, 2% canola/rape, 8% crimson clover and 20% winter pea. This was an option for those producers who felt unable to meet the stipulation of an early September planting date. This mix was designed to have the best chance of survival and performance in the event of late planting. The species were selected because of the following qualities: cold tolerance, winter hardiness, spring growth performance, and safe equine grazing possibilities.

And finally, the Green Cover Basic Mix, shown along with the other mixes in the chart below, was available at a much lower price to producers who purchased seed for extra acreage and needed a more economical option.

Species	Green Cover Basic Mix		Green Cover Nitrogen Builder		Green Cover High Diversity		Green Cover Late Seeded	
	Economy mix of basic cover crop two nitrogen fixers, good biomass potential		Designed for nitrogen addition and fixation ideally seeded by labor day and not terminated until Apr 15 or later		High diversity multispecies mix ideally seeded as early as possible and terminated April 15 or later		Option for late seeding target no later than Oct 15 with termination May 1	
Oat, winter	20	40%			12	24%		
Barley							10	20%
Wheat (SRW)	20	40%	12	24%				
Rye/Triticale			12	24%	15	30%	25	50%
Radish, forage					2.0	4%		
Canola/Rape			1.0	2%	0.5	1%	1.0	2%
Mustard, broadleaf					0.5	1%		
Safflower					2	4%		
Clover, crimson	4	8%	4	8%	3	6%		
Pea, Winter			10	20%	8	16%	10	20%
Lentils	6	12%	6	12%	4	8%		
Vetch, hairy			5	10%	3	6%	4	8%
Total lb./ac	50.0	100%	50.0	100%	50.0	100%	50.0	100%



**MSCC species mix  
seeded in mid-  
September.**

By the third year of the project, local vendors had recognized the market development for a multispecies cover crop seed. Local seed dealers began to offer multi-species cover crop seed themselves, and some participants opted to buy their seed from their local dealers, and certainly, producer-dealer relationships and price leveraging played into these



decisions. However, the project was able to finish the third year with enough volume of seed orders to keep the seed price at an acceptable level. (One local seed dealer placed an order of \$30,000 of seed from Green Cover for the fall of 2015.) This unexpected result of the CIG grant project was that a market for a multi-species seed blend was created, which local dealers jumped to fill, thereby ensuring producers could continue to purchase multi-species seed mixes locally after the program ended.

A summer cover crop mix was offered as well. This served many of the producers in the project, vegetable, small grain and graziers, and was used by approximately 30% of the producers in the project. The first year, the summer cover crop seed was purchased locally at Culpeper Cooperative, then mixed and bagged by Jim Tate, Brian Wooden, Jim Schroering and CJ Isbell. By the second year, demand for the summer cover was high enough to generate an order through King's Agriseed in Pennsylvania.



**Brian Wooden, District Conservationist, Hanover Service Center, checks the delivered seed.**

The summer mix evolved as Jim tried to incorporate new species alongside the proven species. In the final summer of the program, two summer mixes were created. They are detailed below:

**The High Diversity Summer Mix-** This mix consisted of legumes (30%), grasses (51%), brassicas (4%), and other broadleaves (15%). This mix was considered a bit expensive by some producers (total cost per acre \$47.30), and so a more economical mix was planned as well. (The first mix had overstepped the threshold of acceptable cost with producers.)

**Economical Summer Mix-** This more economical mix consisted of one legume (24%), three grasses (52%), two brassicas (6%) and two broadleaves (18%) at a more economical \$26.79 cost per acre.



Jim convinced a number of grazer producers to plant the mix for summer forage, and each participant who tried it was pleased enough to continue it in their forage rotation.

One couple who participated in the project, Angela and David Chainer, joined the project in the spring of 2013, when they planted the multispecies summer cover on 14 acres in Caroline County. In an effort to improve the soil health of the cash grain cropland, they planted five successive cover crops (fall and spring) before converting to pasture. The first summer cover was so heavy that in order to plant the fall cover, the biomass had to be mown and baled. Summer cover was ten to twelve feet high, as shown in the photo below.

In subsequent plantings, the biomass was returned to the soil and eventually, grass was added to the MSCC cover crop mix. The final summer of the project, the Chainers custom grazed a small herd of cattle (11 head) for another grazer, Bruce Johnson, who also participated in the MSCC program. The herd was rotated exclusively on fourteen acres of the multispecies cover crop growth from mid-May until mid-October. Their weight gain is shown in the chart below:



Summer '15

	A	B	C	D	E
1					
2					
3	5/12/2015	11 beef			
4					
5	<b>ear tag</b>	<b>weight in</b>	<b>weight out</b>	<b>weight gain</b>	<b>lbs per day</b>
6	55	553	777	224	1.41
7	15A	572	787	215	1.35
8	6A	661	904	243	1.53
9	1	564	752	188	1.18
10	13A	601	800	199	1.25
11	22A	571	803	232	1.46
12	18A	670	1040	370	2.33
13	16A	634	836	202	1.27
14	5A	657	904	247	1.55
15	17A	606	858	252	1.58
16	10A	485	740	255	1.60
17	<b>totals</b>	<b>6574</b>	<b>9201</b>	<b>2627</b>	
18					
19					
20	<b>date in</b>	<b>date out</b>	<b>no. days</b>		
21	5/12/2015	10/18/2015	159		
22					
23	<b>total weight in</b>	<b>avr. weight in</b>	<b>tot. weight out</b>	<b>avr. weight out</b>	
24	6574	597.64	9201	836.45	
25					
26	<b>total gain</b>	<b>price per pound</b>	<b>value of gain</b>		
27	2627	\$0.60	\$1,576.20		



**Bruce Johnson's cattle grazing summer cover crop in August 2015**

## **Findings**

Staffers felt that there were several mechanisms of the project that played into its overwhelming success. One was the relationship and trust between the districts' staff and partners and the producer participants, some relationships spanning many years. Support from the partners also brought many referrals into the program.

Second, the basic concept of the program was one that producers understood, and this willingness to embrace innovative ideas has been a common feature among the high quality producers in Central Virginia. The ideas proposed to them were not a totally new concept; they had some background exposure.

The ability and willingness to formulate multiple mixes that met the producers expressed concerns, which was tailored to their needs without huge constraints, very likely contributed to the acceptance of the multispecies cover crop. This successful tailoring of the mixes strongly suggested that a "one size fits all" approach would not work. Ultimately, the decision to tailor one mix for late planting allowed producers to plant a significant amount of additional late soybean acreage that would not have met the program guidelines for an early September planting.





**Farmers fill out survey at the Producers Survey Breakfast**

A survey was taken at the end of the project to gather information about what the farmers learned from the program. Twenty one of the thirty five producers responded to the survey. One hundred percent of responders indicated the project benefited their operation and all were more interested in cover crops.

95.24% felt they had been exposed to a cover crop species they might not have tried if they had not been in the program. Producers expressed further interest in trying additional varieties of cover crops.

89.47% saw more biomass than cover crops they had used in the past.

88.9% observed changes in the soil over the three years.

100% stated willingness to participate in a follow up project.

68.75% observed changes in germination, fall and spring growth or biomass that would cause them to modify their management.

61.90% planted more than the five acre test plot.

100% observed no real weed problems caused by the cover crops.

80% had no difficulty with terminating the cover crop. Many experimented with the amount of biomass allowed to develop before termination.

89.47% did not modify normal termination procedures.

80% had no experience rolling down cover, and 65% expressed an interest in rolling down cover.



100% came to the conclusion that high volume biomass could reduce chemical inputs and increase infiltration.

90% of participants believed that the project influenced their thoughts about cover crops, 85% of those were considering changes in management.

70% saw the possibility of adding a high biomass summer cover to their rotation and 75% were willing to participate in a summer cover follow up project.

52.9% expressed their interest in participation in a 15 inch row planted cover crop project.

85% considered the biomass manageable in planting the next crop.

The districts did much to publicize the CIG funded project, with field days, demonstrations and appearances at forums and meetings, as well as contributing to research at Virginia Tech.

Cover crop demonstration plots were planted outside the Hanover-Caroline SWCD office in the fall of 2012 at the beginning of the project, to demonstrate different cover crop species in comparison to the multispecies cover crop. The large one, a 100' x 100' plot, was planted using the same custom mix distributed to producers. Informational signs to denote the demonstration plot were ordered and placed. Ten smaller plots of 10 different species were planted as well, with one half of each of those plots fertilized. The intention was to demonstrate the effect of starter fertilizer on the growth of biomass and the development of cover crops other than small grains.



In December of 2012, the districts were involved in mapping the plots for researchers at Virginia Tech. Jim Tate led the contingent around the central Virginia area to take soil samples from project plots for research by Rob Norris, a Virginia Tech graduate student involved in research with Wade Thomason.



In February of 2013, the districts planned a Growers Conference, which was held at University Hall at the University of Mary Washington in Fredericksburg. Some of the project participants and other producers were bused from the Northern Neck to Fredericksburg to attend the event. Speakers of national prominence were brought in for the event, and local central Virginia farmers participated in a panel about their experience with cover crops. Speakers included:



Jay Fuhrer, ND NRCS

Agricultural Economics from North Dakota State University. Jay spoke on Soil Health.



Dr. DeAnn Presley

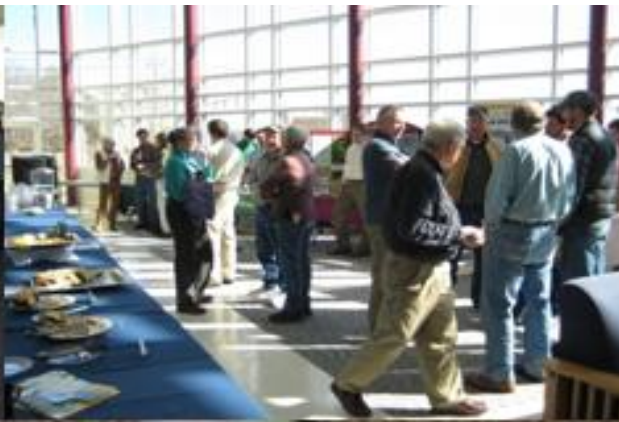
Dr. DeAnn Presley, an assistant professor in Environmental Soil and Science Management with the Department of Agronomy at Kansas State University, spoke on Vertical Tillage Effects on Soil Quality.



Dr. Wade Thomason

Dr. Wade Thomason, Professor in the Department of Crop and Soil Environmental Sciences as Extension Grains Specialist, gave an update on Virginia cover crop research.









An NRCS event to roll out the Soil Health Initiative, hosted by the district, was held in March of 2013 at Engel Farm during the first year of the grant project. The Hanover-Caroline SWCD provided a Caroline County producer's sample of the multispecies planting (from the grant project) planted in 100% no till soil for a rainfall simulator demonstration presented by Chris Lawrence, NRCS State Agronomist. Shown in the picture below, the rain simulator display included a multispecies cover crop planting from a project participant in Tray 2 of the demonstration. Among four scenarios, the only jar without any storm water and sediment runoff was the multi-species cover crop. Since all rainwater was absorbed, no soil sediment was deposited, purportedly because of the thick multi-species cover in place and excellent soils resulting from continuous no till.



One of the multi-species cover crop mixes was planted in a research plot at the Orange ARS Station in the fall of 2013, and shown along with many other cover crop species at a Field Day on May 18, 2014.





**Forage and Livestock Field Tour at Keenbell Farm, September 2013**

On September 10<sup>th</sup>, 2013, a grazing pasture walk was held at Keenbell Farm in Rockville, Virginia. This Forage and Livestock Field Tour highlighted the pasture rotational grazing of cattle utilizing the multispecies cover crops summer mix. Dr. Chris Teutsch, Associate Professor of Forage and Livestock of the Southern Piedmont Agricultural Research and Extension Center, led the pasture walk, along with Dr. Brian Campbell, the Ruminant Livestock Production Specialist at SPAREC.





### **Cover Crop and Soil Health Field Day at Keenbell Farm September 2014**

In September of 2014, the districts held the “Cover Crop and Soil Health Field Day”, which was also held at Keenbell Farm, with the indoor portion of the program held at a nearby church. C.J. Isbell, the young producer, discussed the role of cover crops on their sustainable farm. “Soil Health, What It Means, and Why It Matters” was presented by Chris Lawrence, along with “Digging Deeper into Cover Crops and Their Benefits” by J.B. Daniel. Another presenter, Jason Martin, spoke to producers on “The Power of Pollinators”, and pollinator materials were distributed to producers. A guided field tour of the farm was held in the early evening before the program conclusion.

A booth was held during the 2013 and 2014 State Fairs for one day to educate the public about multi-species cover crops. Jim Tate manned the displays.



**Jim Tate working the MSCC Booth at the Virginia State Fair in September 2014.**

In December of 2014, producer participants in the CIG Grant project were presented with the NRCS Virginia Earth Team Outstanding Partnership Award, and the award was presented at the VASWCD Annual Meeting in Roanoke. Some producers attended the presentation.





In February of 2015, Marian Moody and Sharon Conner of the Hanover-Caroline SWCD, traveled to New Orleans to attend the national meeting of the National Association of Conservation Districts. The MSCC CIG Grant project was selected for presentation at the Share Fair for the attendees at the national meeting, and the project attracted a large crowd of interested people, interested in the multispecies cover crop and the CIG Grant. Samples of the mixes were handed out, and well received.



The CIG Grant project was mentioned in an article which appeared in Progressive Forage Magazine in their November 15, 2013 article about one of the producer participants in the grant, Howard Smith of Mica Mine Farm in Beaverdam, Virginia. Howard spoke of his participation in the NRCS Conservation Innovation Grant, and Jim Tate was quoted about the producer's experimentation with the mix.



**Picture of Howard and Josh Smith which appeared in the article “Innovation and Motivation at Mica Mine Farm” from *Progressive Forage Grower*, November 15, 2013, pg. 16.**

Other outreach presentations made by district staff about the CIG Cover Crop grant were:

NRCS Soil Health Training held at Virginia State University

CCA meeting at Koger Center, January 23, 2013.

Virginia Soil and Water Conservation Society, November 7, 2013.

State Fair Demonstration, September 2013 and 2014.

Virginia Soil and Water Conservation District Annual Meeting Breakout Session, December 10, 2013.

Provided seed mix samples for 2015 Vantage Meeting in Harrisonburg, Ag Expo in Fishersville, VA, numerous winter producer meetings, Cover Crop events and dairy expos over the three year project period.

Presentation to students at Stonewall Jackson Middle School in Mechanicsville, VA on January 14, 2014.

Held a Producer Wrap-Up Survey Breakfast in July 2015 in Ruther Glen, VA.

Provided seed for NRCS and Va. Cooperative Extension summer forage test plots at Raphine, VA in 2014, and participated in their Field Day.

Social media presence with articles and postings about cover crops:

Hanover-Caroline District Facebook Page

<https://www.facebook.com/hcswcd/fref=ts>

District Homesteading and Homegrown Facebook Page

<https://www.facebook.com/groups/507322519284850/>

7 Facebook groups.

Article on Cover Crop Field Day for VFGC website, on Nuckols Field Day, 2015.

<http://vaforages.org/>

Correspondence and advising with numerous individual producers on the *Cattle Today Forum*.

Two videos on Multi-species Cover Crops in Central Virginia specifically tailored towards small grain producers have been produced, and two targeted toward graziers have been completed and all promoted on social media. One of the videos has reached 6956 views at last count, including being shared on Virginia Association of Biological Farming's and International Wine Country's social media. One new video geared towards dairy producers is in the works.

Not every producer in the project had the same results. Not every producer was passionate about making their plot successful. But many saw results and became believers. Many producers have continued to plant multispecies cover crops after the conclusion of the project.

One dairy producer saw results in his corn, and went from planting 11 acres in the first year of the project to 140 acres in the final year of the project. He continued to plant the MSCC seed after the project concluded. He will be the subject of an upcoming video.

Another producer was convinced by his results to create a cover crop seed blending business.



## **Conclusions and recommendations:**

More time should have been scheduled for site visits, sampling and photo documentation. The project was handled by district staff in addition to their normal responsibilities.

Other lessons learned during the project were:

Mixes should be designed with a particular purpose in mind. Cover crops were accepted more enthusiastically when there was a secondary purpose which benefited the farmer with results the same season, and therefore increased participation and acreage. There was no one size fits all mix that could be all things to all producers. The inability to meet everyone's needs gave birth to the idea of multiple seed mixes. In particular, the late seed mix allowed additional acreage to be planted and attain cover.

The districts also learned when taking orders for additional seed that payment should come up front, thereby eliminating the problem of slow payers. The district eliminated this problem by instituting an online ordering and payment process.

Doing the research on the individual species to prevented problems for the producer. For instance, Jim Tate almost put foxtail millet in a summer mix, but found out through research it can be problematic for horses, causing liver and kidney problems. Another discovery made involved a summer mix which included buckwheat on a plot destined for collards. Buckwheat is a prolific seeder, and there can be several generations within one summer.

Mike Combs, an NRCS District Conservationist at the Gloucester Service Center in Virginia, tried the summer cover crop mix ahead of planting collards. Unfortunately, the buckwheat voluntary seed overtook the collards and became a tall weed in the collards planting. There was a small drop in production, but one that Mike considered "too close for comfort". Fortunately, Mike discovered the collards had no need for pesticide, because there were no pest problems. Mike speculated this may have been a result of the beneficials that were drawn to the buckwheat blooms.

It was discovered that yellow clover was a bit too finicky for a good cover crop stand, even though it is a great conservation plant. On the other hand, Balsana clover seems to have some promise.

In some cases, a boost from starter fertilizer was seen to be beneficial in getting a jump start to the cover crop. Manure and compost were used by dairy producers, and graziers benefited from manure left by the grazing cattle.

Some producers also made comments about weak areas in fields which were revealed by the multispecies cover crop. One producer actually soil tested the weak areas shown by the crop and discovered a lower pH in those areas and made corrections. Producers who used cover crops on newly cleared land found some disappointing stands and found that some amendments made a dramatic difference.

It was discovered that the \$40.00 to \$45.00 per 50 lb. bag was the upper range of what was acceptable and affordable to producers for cover crop seed. This discovery was made during the process of taking orders for extra seed. Seed prices have continued to rise, and blending an economical multi species seed mix is becoming more difficult.

District staff learned to stress the importance of early planting of the mix. Some producers planted the mix in the first year in late October, and the radish seed did not have enough time for optimum growth before winterkill at about 17 degrees or below. The best benefits of tillage radishes resulted when planted before Labor Day. Also, the turnips did not winter kill the first year of the grant project, and were a problem for two of the producers. They were taken out of one of the mixes in the second year.

The Dwarf Essex Rape, Crimson clover, and hairy vetch (or wooly pod vetch), were great soil building crops that performed well in the mixes, seeded easily, grew well together, and were beautiful bloomers in the spring. They produced flowers early in the season, which was favorable for the pollinators and other beneficials. Their outstanding traits for deep roots, nitrogen fixation and storage made a valuable contribution to the multispecies cover crop mixes.

A small survey was completed involving sixteen producers in the project. These producers used the same plot over the entire period three year period, as per the parameters of the project. Of those sixteen, six of the producers used no till equipment as the way to plant their multi-species cover crop. Three of the producers broadcast and turbo tilled the planting of their cover crop. Four did a light disking and drill. Three did light spin spreading and disking.

Of the sixteen producers queried, seven of the producers used chemical burndown to kill the cover crop. Three others used mowing and planted his next cover crop into the mown plot. Three producers chose to disk and/or till in their cover crop.

Almost all of the producers killed their cover crop in the April-May period for the fall cover crop, one in March, and summer cover crop producers killed their cover in September. Only one of the fall planting producers allowed his to grow until June, this was one of the successional planters. He allowed it to grow until June in one year for the benefit of wildlife. The four vegetable producers who were queried terminated their cover crops in early April for early vegetables in the Northern Neck.

Three of the producers in the project planted a successional planting of cover crops over the period of three years with the goal of increasing the soil health on poor land. These were the

producers who experienced the most change in the soil health of their fields. Two of the three fields tested achieved a soil health calculation of 7, and the other of those three achieved a significant rise in their soil health calculation, based on the Solvita soil health tests.

According to Rick Haney with USDA-ARS, “the calculation looks at the balance of soil carbon and nitrogen and their relationship to microbial activity”, and “represents the overall health of your soil system.” The range is from 0 to 50, and the goal is to reach and keep a calculation of 7 or above.

However, the district staff felt that there was too much variance in conditions to be able to make comparisons of other soil test results. Two extreme weather years during the three year project, annual changes in the mixes, and use of different mixes prevented a fair comparison of producer results. A longer project time frame would be needed to determine significant changes in the soil health, or a concentrated effort similar to the three producers who planted successional plantings.

In conclusion, the project influenced the successful planting of 4770.5 acres with 164,827 lbs. of cover crop seed. The MSCC mixes were created for and used by a diverse range of agriculture, namely vegetable, dairy, beef and small grain, and for the improvement of poor or newly cleared land. A market for multi-species seed mixes was created during the period of the project, and local dealers began to carry similar mixes. The staff involved with the grant have continued to see the multi-species cover crops implemented on acreage within central Virginia in the season following the project conclusion. And finally, videos promoting the use of multi-species cover crops have been made and placed on social media, with more currently in production. The project has succeeded far beyond the hope and expectations of staff, and the innovative producers of the central Virginia region involved in the project deserve the recognition for that success.

## **Grant Deliverables**

- 1. Conduct over the life of the project a minimum of 75 on-farm demonstrations consisting of multi-species cover crop plantings. It is recommended, but not required, that demonstration be equally distributed across project years (eg, 25 demonstrations x 3 years = 75 total demonstrations).*

The project had a thirty five producers who participated over the course of the three year project, each planting a minimum of one cover crop each year. The project lost two producers at Henricopolis after the first year, but others joined the project to take their place.

- 2. Ensure that the above cover crop demonstrations consist of approximately five (5) acres seeded to diverse mixes containing at least one species from each of the*



*following groups- grass, nitrogen-fixing legume, and non-nitrogen-fixing broadleaf (forb).*

The district ensured that each seed mix was planted, and producers far exceeded the requirement of a five acre planting by purchasing additional seed mix themselves for planting.

3. *Ensure the following minimum elements are included in at least 50 of the project's cover crop demonstrations:*
  - a) *Demonstrations will include at least one comparison designed to show the impact of multi-species cover crops on the performance of the subsequent harvested crop. Examples of possible comparisons include but are not limited to: subsequent crop yield on cover cropped area vs. adjacent non-cover cropped (control) area; subsequent crop response to normal vs. reduced nitrogen (N) fertilizer on cover cropped area; etc. More sophisticated comparisons are recommended whenever possible.*

The project partners lost staff in the first year of the project, and the project staff was unable to do all the soil testing required in the project. However, final soil tests have been taken to compare to the beginning status of fields planted with the MSCC cover crop. They are still being processed and will be provided in the final report.

- b) *Whenever possible, demonstrations should be located on the same sites for multiple years in order to evaluate the impact of repeated cover croppings on performance of subsequent crops and soil health and properties.*

Field days were held at Keenbell Farm on two different occasions to show MSCC purpose and possibilities. Ten producers planted the mix on the same acreage over the three year period.

- c) *Each cover crop demonstration will be designed and managed to facilitate collection of the data listed below.*
4. *To the greatest extent possible, collect, analyze, and summarize (when appropriate in map format) the following data at least 50 of the project's cover crop demonstrations.*
  - a) *Previous crop and soil management history for the demonstration areas.*

Not kept because of staff loss.

b) *Cover crop management details (cover crop species, seeding rate, timing of seeding, inoculation at seeding, timing and method of termination, approximate growth stage at termination, etc.*

c)

Information about timing of seeding, timing and method of termination are in the Findings section. It was also difficult (if not impossible) to get reporting from the producers because the planting season for cover crops is also harvest season for their other crops. This corresponded to busiest times of the year for district staff as well.

d) *Qualitative or descriptive evaluation of cover crop performance.*

Yield monitoring was abandoned because of lack of equipment and staff.

Descriptive evaluation shown in videos.

e) *Description of harvested crops planted after cover crops in the demonstration and qualitative and/or qualitative evaluation of harvested crop performance (yield, etc.)*

Records not kept for harvested crops planted, however, producer reaction of purchasing additional amounts of cover crop seed in second and third years of project speaks to the successful results seen by the producers. One dairy producer went from 11 acres of planted MSCC in his first year to 140 acres in the final year of the project, putting the MSCC on all his corn acreage.

f) *Any and all details pertinent to comparisons showing impact of multi-species cover crops on subsequent crop performance. Examples include differential nitrogen fertilization rates applied to cash crops following cover crops and associated yield responses.*

No records kept on comparisons or impact of MSCC on subsequent crop performance.

g) *Estimate of economic impact of multi-species cover crops on profitability.*

The staff on the project learned through the sales of additional cover crop seed that the upper limits of price acceptability was in the \$40.00 to \$45.00 range. The farmers believed higher prices would affect their profitability.

5. *Partner with appropriate Virginia land grant university system and/or Virginia Cooperative Extension (VCE) personnel in planning and designing the above demonstrations and in analyzing and interpreting associated data.*

The grant project did assist Virginia Tech grad student with collecting information, data and sampling in his cover crop study in the first year of the project. Loss of our Extension partner prevented further data gathering during the project.

6. *Conduct qualitative and/or quantitative soil assessment at representative demonstration site to investigate impact of multi-species cover cropping and manure injection on soil health and properties. Project managers will collaborate with appropriate Virginia land grant university system and/or VCE personnel in selecting appropriate soil assessment procedures and interpreting results.*

Loss of Extension staff involved in the project, and loss of the graduating grad student prevented more study and assessment procedures and interpretation of results.

7. *Provide participating farmers, in a timely manner, with data associated with their demonstrations in order to maximize farmer engagement in the project and boost farmer understanding of the costs and benefits of the practices.*

First year results were shared with producers. Final soil test results will be shared as well.

8. *Organize at least two producer forum meetings during the life of the project to help participating farmers and other interested individuals better understand the project as well as to collect farmer input and suggestions.*

The Vantage Meeting in February 2013 was held in Fredericksburg, Virginia to bring in national speakers, and Jim Tate was on the agenda to speak about the project, as well as a producer panel of central Virginia producers. Winter producer meetings were held each year of the project, sponsored by the districts, to update producers on the grant project.

9. *Explain project activities and results to Virginia farmers and their advisors at a minimum of two winter agricultural conferences and/or summer field day events over the life of the project (in addition to the two farmer forums described above).*

Two Field Days were held at Keenbell Farm. Jim Tate occupied a booth at the State Fair of Virginia to speak to the public about the multi-species cover crops in two years. Jim advised all dealers and vendors who called and considered stocking the multi-species mixes, when vendors wanted to make the cover crop mixes available.



The grant project provided seed for demonstration field plots which were highlighted in Field Days at Orange Research Station. Outreach presentations and seed mix samples were given out at numerous agricultural conferences and meetings including VASWCD Annual Meeting (where Jim Tate was a general session speaker, and a breakout session speaker).

- 10. Ensure that at least one of the four above events includes explanation of the importance of pollinators and promotion of farming practices benefitting pollinators.*

The Keenbell Farm Field Day 2014 included a speaker about pollinators and distribution of materials.

- 11. Whenever possible, collect and summarize feedback from farmers participating in the cover crop demonstrations*

Yes, feedback was taken from producers from the beginning, and mixes were changed according to feedback. It was this feedback that gave birth to a selection of mixes that met the needs of the producers. The experiences of several producers are shared in the final report.

Also, four videos giving testimony to the results of the cover crops used for grazing were produced and published on social media after approval by NRCS. Another video involving a dairy producer involved with the project is planned for the spring.

- 12. Develop at least one final document summarizing the overall findings and lessons learned from this project on a case study format. This document should include a summary of any participating farmer feedback. The primary audience for this document will be farmers and their advisors. It is strongly recommended, but not required, that this final document be developed in partnership with VCE specialists and take the form of an official Virginia land grant university system publication.*

Jim Tate has collaborated on a fact sheet with Chris Lawrence to meet the deliverable. Having lost the VCE agent when he took another position, the district was not able to deliver on a publication with a Virginia land grant university.

- 13. Participate in at least one state CIG showcase or other comparable event in Virginia designed to highlight projects supported by Virginia NRCS CIG (if NRCS organizes such an event).*

Jim Tate has participated in numerous programs for NRCS, including one JED training at VSU, and another in January 2016.

*14. Emphasize in all presentations and documents associated with this project the financial assistance provided to the project by Virginia NRCS and the CIG program.*

The staff on the grant project has complied with this requirement. When attending the Share Fair in New Orleans in February 2015, many of the attendees were just as interested in the CIG grant as the cover crop project itself. Staff answered many questions about the grant process.

Also, all videos produced have included the message that financial assistance came from a NRCS Conservation Innovation Grant

*15. Publicize when appropriate in presentations and documents associated with this project the NRCS financial assistance programs available in Virginia related to cover crops.*

The district did use contacts involving the VA BMP Cost share Program and the grant project to promote the financial assistance programs with NRCS. We have been very fortunate to have a great relationship and partnership with our District Conservationist, Brian Wooden. The producers in our project were very progressive in seeking out and coordinating NRCS programs that would incorporate the grant project, and the District endeavored to educate new clients in the grant program on federal and state programs that would best suit their circumstances and plans.

*16. Based on lessons learned from the project, provide in the final report to NRCS formal written recommendation on improvements to NRCS cover crop and soil health incentive programs in Virginia.*

The staff felt the program went hand in hand with the developed incentive programs already in place with NRCS, and complimented each other, and could not think of any improvements that could be made.

*17. Submit the following reports to NRCS summarizing progress and/or outcomes with respect to each of the deliverables described above:*

- a. All reports were submitted as appropriate.
- b. Final report draft submitted.
- c. Federal Financial reports submitted.

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